Transition Engineering Course

Ideas Beyond Targets

Mechanical Engineering Masters Students block course on Transition Engineering, and projects to eliminate fossil fuels

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Change an existing system, no matter how small, to eliminate the need for fossil fuel

More than 40 Masters of Engineering students in the energy and thermal systems engineering programme at Duisburg-Essen enrolled for a block course on Transition Engineering. The students had previously studied Mechanical Engineering and were familiar with energy conversion technologies. The students were from India, Africa, Malaysia, and Morocco as well as from Germany. The block course consisted of 8 hours of lecture, reading and a research, and a brainstorm team project for seminar credit.

Learning Objectives:

- Learn the current science of climate change and resource depletion, and be able to recast the science scenarios into engineering project requirements.
- Learn to recognise the current frames used to discuss energy, electricity, renewable energy, green energy, sustainability, and the substitution of alternative energy sources and technologies. Learn the basic premise and calculations for economic analysis and to model growth. Understand the meaning, methods, and implications of lifecycle cost assessment (LCA), and energy return on energy investment (EROI).
- Learn the Transition Engineering framework and the methodologies used for understanding the historical dynamics of systems, characterize the un-sustainability risk of future scenarios for business as usual, technology wedges and efficiency improvement, and set a time-frame and develop a probability space for the forward operating environment.
- Learn the idea of path-break long-term thinking by imagining time travel to the same location 100 years in the future where the necessary actions had been taken in to avert catastrophic climate change and energy system failure.
- Learn how to use the Strategic Analysis of Complex Systems approach to develop trigger project opportunities, and to communicate these opportunities to a range of stakeholders.

A guided series of brainstorming steps was then carried out. The teams worked hard, discussed possibilities, and had creative fun. The students initially found it very difficult to contemplate the idea of change that eliminated fossil fuel. Exploring the future was found to be interesting and challenging. The current system without oil would be a total system failure. But thinking about this situation is not the same as exploring the future, where the current system is history, and it was successfully changed to not require oil, and to be much better than the current system. The transition is accomplished one project at a time. All fossil fuel can't be eliminated in all systems at this moment, but non-productive and non-essential uses of oil, coal and gas can be eliminated in many systems as trigger projects. In the near future, as technology, buildings and infrastructure age, they can be re-developed to be free from fossil fuel dependence. The students got instruction on how to carry out a creative brainstorm process, and were formed into teams around several ideas for research a development of trigger projects.

The teams will carry out research into the history of the energy system, the current activity system, costs and policies, and investigate future scenarios. They will prepare and present the research and a description of a trigger project to the rest of the class and Professor Burak Atakan in January for assessment.

The potential themes that emerged from the brainstorming work included personal transportation and urban form in Duisburg, arresting the development and thus commitment to fossil fuel use in India, and transition of automobile manufacture to cycles & trams.

One student from India remarked, "Maybe we are lucky that we didn't waste money on development around fossil fuels. Probably the so-called developing countries could actually come out much better in the future if we skip the mistakes of the developed countries."

Location, Location, Location:
In the city of Duisburg, and many other German cities, the actual urban form is walkable and cyclable, but the city is choked with vehicles because people choose residential properties based on criteria that may include location near their activities, but not as a high priority except perhaps for university students. Looking at history, the early 1900's for example, the city of Essen had massive factories and steel manufacturing facilities employing tens of thousands of workers, none of whom used private automobiles to get to work or shops, or their children to school. That urban form is still largely in place. The pervasiveness of private automobiles in cities where people don't actually need them is not an isolated issue for Germany. The first question for the transportation energy transition is "how much adaptive capacity" does a given city actually have?

The students brainstormed the idea for an App that people could use to develop an activity system map, tracking their phone's GPS locations over time and building a heat map of their "territory". The App would also tie in with real-estate databases, and match people up with properties that come available that fit their profile. The data would also inform real estate developers and city councils about where people are looking for and able to transition to car-free living. The App data can also be used car-sharing and public transport and city planners. From car registration data, people could be given incentives to move into the range of their activity systems and give up their vehicle ownership. The App could be part of the engineering to utilize the adaptive capacity of a city to transition to fewer and fewer cars. As fewer cars are on the road, the walkability and cyclability of the city becomes enhanced, the investments in reducing car parking and improving cycle and public transport infrastructure become more economically positive for the city, and the money kept in the economy instead of being exported to pay for oil and all of the costs of vehicles is spent on local improvements, services, entertainment and retail. The class discussed how such an App would probably be useable in nearly every city in Europe.

The Next Generation of German Engineering and Manufacturing:

Currently in Germany, oil for transportation and coal for manufacturing and construction are the biggest carbon emissions sectors. Looking at the whole sector of transportation, it is clear that the footprint of the personal automobile is huge in terms of carbon, costs, pollution, damage, land use, injuries, economic inequality and many other problems. The students brainstormed around transition of the personal automobile world. The idea of road and vehicle infrastructure becoming a sunset industry, along with vehicle engineering and manufacture was hard to imagine until we started imagining it. In the late 1800's the manufacturers of locomotives could not have imagined that their industry would transition to personal vehicles. Likewise, over the next decades, engineering and manufacturers who transition early to engineering of perhaps customized human powered vehicles of all varieties, ways to move goods and wastes using electric tram systems, and other innovations of the post-automobile world will be the leaders. For example, why not have custom body-fitting and electric power boost for each customer, engineered to fit their travel needs and physiology? Why not make a science and engineering industry of custom cycles for each purpose and each family and each stage of life? Cycle parking, shelter of cycle-ways, and re-engineering of the signals and intersections for the post-oil world are all areas where Germany could take the lead.